Technical Specifications

"Deployment System with Spherical Electrodes for Sounding Rockets"

1. General Description

a) The deployment system or boom assembly described herein shall, upon receiving a command signal, symmetrically deploy two opposing (180° apart) spherical (hollow) aluminum sensors (6 cm diameter) compactly housed in a relatively small, cylindrical sounding rocket payload.

b.) The final (deployed) configuration shall enable the sensors and boom elements to lie along a single measurement vector which itself shall be situated in a plane perpendicular to the central (spin) axis of the payload. The distance between the inner edge of the fully deployed spheres shall be 6.0 meters.

c.) The deployment assembly shall extend its internally housed booms using internal, stored mechanical energy and shall not require an external power supply to supply the deployment energy.

d) The presence of the spherical sensors must be taken into account when considering the overall boom assembly constraints described herein.

e) The entire assembly must be capable of withstanding intact the vibrational forces, mechanical stresses, and thermal effects experienced on board typical sounding rocket vehicles accelerated from the earth's surface along ballistic trajectories with apogees in the earth's upper ionosphere (~1000 km altitude).

f) The boom assembly described here shall be fabricated, assembled, tested, and delivered as one system, including the spherical sensors.

2. Dimensions

a) The fully-extended (deployed) booms shall measure 6.0 meters tip-to-tip, exclusive of the spherical sensor dimensions.

b) The outside diameter of the boom shall be less than 3 cm for the entire length of the fully deployed boom element and less than 1.5 cm for the outer 0.5 m of each fully deployed boom element.

c) The entire deployment/boom assembly including spherical sensors shall be designed to fit inside a 16.5" (41.9 cm) inside diameter sounding rocket payload.

d) The maximum vertical height of the assembly inside the payload shall not exceed 4.0" (10.16 cm).

e) The mass of the entire boom assembly shall not exceed 5 kg. The mass of the boom assembly should be distributed as symmetrically as possible about the payload central axis.

f) The boom elements and spherical sensors shall be designed to extend out of the payload through small opposite openings in the payload skin, each measuring 4.0" x 3.35" (10.16 cm x 8.51 cm).

3. Rigidity Requirements

   a) The bending capacity of the deployed boom elements must be at least 150 in-lbs.

   b) The bending stiffness (EI) of the deployed boom elements must be at least 20 x 10^3 lb.-in^2.

4. Deployment Characteristics and Monitors

   a) The boom elements shall be designed to deploy upon command from a brief electrical signal pulse furnished from inside the payload assembly.

   b) The release mechanisms for deployment shall constitute part of the boom assembly. No external energy source (e.g., electrical power) shall be used to provide the energy source to mechanically deploy the booms.

   c) The booms shall be designed to deploy at a vehicle spin rate between 0.5-3.0 Hz.

   d) The booms shall fully deploy in less than 20 seconds.

   e) For reasons of payload dynamics and stability, the two opposing boom elements shall deploy simultaneously and in a symmetric manner.

   f) An analog potentiometer or toggle switch shall be furnished as part of the boom assembly in order to show the position of the ends of the boom elements in the stowed, progressively deployed, and fully deployed positions. The end contacts and wiper contact of the potentiometer shall be made available via a connector on the boom mount in the payload body. Calibration curves of resistance vs. deployment distance or toggles *vs*. deployment distance shall be furnished in order to evaluate the potentiometer data.

5. Boom Element Characteristics and use as Sensors

   a) The boom elements shall be made of highly conducting material (e.g., Aluminum, Beryllium Copper).

   b) The boom element shall be electrically connected to a pin on a connector situated so that it can be easily accessed in the payload assembly.

   c) The boom element shall be coated with an insulating material except for a small "exposed" portion (typically 10-30 cm) to be specified later.

   d) The boom assembly chassis inside the payload shall have a layer of insulation attached to the side on which it is mounted to the deck in order to insure that the assembly is electrically isolated from the payload body.

6. Signal Co-Axial Cable and Connectors

   a) Co-axial cables shall be routed through the boom elements and permit electrical connection to the spherical sensors at the ends of each boom via a

commercially available snap-on or screw-on connector. The other end of each co-axial cable shall be connected to a pin on another connector situated so that it can be easily accessed inside the payload assembly. The shield of the connectors shall be electrically insulated from the rest of the boom assembly.

b) The input impedance of the co-axial cable shall be 50 ohms.

c) The capacitance per unit length of the co-axial cable shall not be greater than 30 pF/ft (98 pF/m).

d) The resistance between the co-axial center conductor and the co-axial shield shall be at least 10^{12} ohms.

e) The resistance between the co-axial shield and the mounting plate shall be at least 10^{12} ohms.

f) The resistance between the boom element and the mounting plate shall be at least 10^{12} ohms.

g) The above resistances (d, e, and f) shall be measured for each boom half. The results of these measurements shall be furnished with each boom assembly.

h) In addition to the coaxial wires, three small diameter, insulated wires shall also be routed through the booms, providing electric connections at the ends of the booms. A connector shall be provided to allow a simple installation of the electronics to be housed in the sphere.

i) Specific details of all connector and wires shall be finalized after award of contract.

7. Sphere Assemblies

a) Hollow, thin-shelled aluminum spheres shall be provided that are attached to the outer tips of the booms. The spheres should consist of two halves that are fastened or screwed together for flight. The sphere halves shall come apart in order to provide access to the circuit board inside (see item b below.)

b) The hollow spheres shall include a means to secure a small circuit board (not provided as part of the deployment and sphere assembly) in its interior to which the wires and cables discussed above will be attached.

c) The outer sphere diameter shall be 6 cm. The mass of the sphere assembly shall be less than 85 g (not including the internal circuit board.)

d) A short (2-6 cm) rod shall extend outboard of each sphere (i.e., in the direction opposite the boom) to provide symmetry about the sphere of the boom. This "shadow equalizer" shall have the same diameter as the boom at the sphere interface. The exact length of the rod depends on available space in the payload and will be determined later.

END OF SPECIFICATIONS